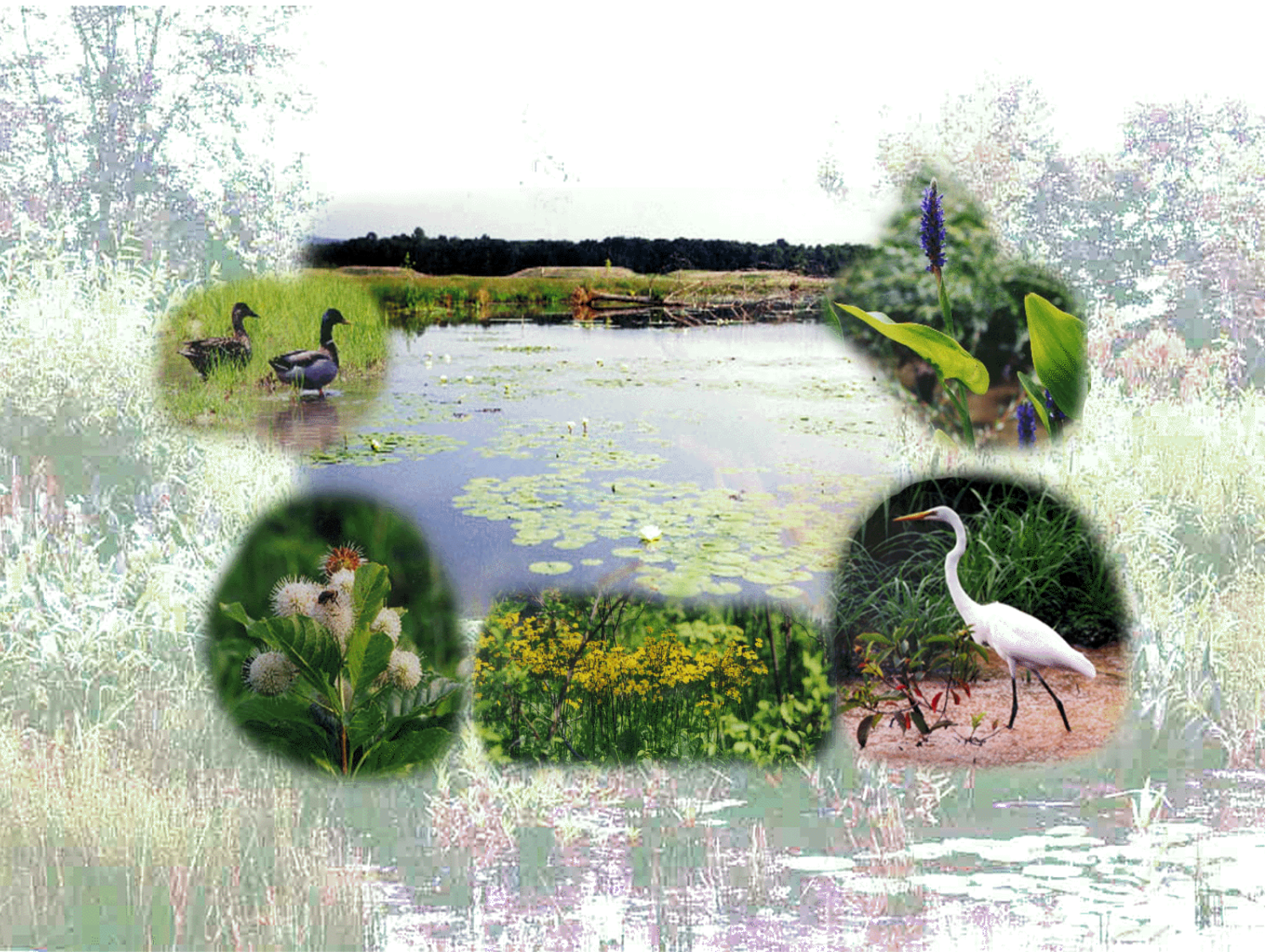# Commonwealth of Virginia's
Wetland Monitoring & Assessment Strategy
October 2005

Office of Wetlands & Water Protection

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INTRODUCTION

A key aspect of the Commonwealth of Virginia's nontidal wetlands program is ensuring that there is no net loss of wetland acreage and function through permitted impacts. During its 2000 session, the Virginia General Assembly passed legislation to amend State Water Control Law to, among other things, address no net loss/net gain goals for the Commonwealth's wetland resources. § 62.1-44.15(16) of the Code of Virginia lists as one of the powers and duties of the State Water Control Board "[*t*]*o establish and implement policies and programs to protect and enhance the Commonwealth's wetland resources. Regulatory programs shall be designed to achieve no net loss of existing wetland acreage and functions. Voluntary and incentive-based programs shall be developed to achieve a net resource gain in acreage and functions of wetlands.*" In addition, as part of the multi-state Chesapeake 2000 Agreement, Virginia has agreed to the Major Desired Outcome for Wetlands (Chesapeake Bay 2000 Agreement, Subsection 2.3) to *"(i) achieve no net loss of existing wetland acreage and function through regulatory programs; (ii) achieve net wetland resource gain through wetland restoration; and (iii) assist local governments and community groups with development of wetland preservation plans as part of integrated locally based watershed planning."*

The Virginia Water Protection Permit Program (VWPP), in DEQ's Office of Wetlands & Water Protection, regulates impacts to tidal and nontidal state waters, including wetlands. This permit program also serves as Virginia's Section 401 certification program for federal Section 404 permits. Application is made through the joint permitting application process for concurrent federal and state project review. In 2000, the Virginia General Assembly removed the dependence of the State's nontidal wetlands program on the issuance of a Federal permit, thus enabling DEQ to use the VWPP program to regulate activities in all wetlands that meet the scientific definition. Certain types of excavation in wetlands and fill in isolated wetlands (which may not be regulated under Federal jurisdiction) were added to the activities already regulated through the Section 401 Certification process. DEQ can provide Section 401 Certification through issuing a VWP individual or general permit or by certifying U.S. Army Corps of Engineers nationwide or regional permits. Activities requiring a permit include dredging, filling, or discharging any pollutant into or adjacent to surface waters, or otherwise altering the physical, chemical or biological properties of surface waters, excavating in wetlands, or on or after October 1, 2001, conducting the following activities in a wetland: new activities to cause draining that significantly alters or degrades existing wetland acreage or functions; filling or dumping; permanent flooding or impounding; new activities that cause significant alteration or degradation of existing wetland acreage or functions. This would include any project that requires a Clean Water Act Section 404 permit or a Rivers and Harbors Act Section 10 permit, or a water withdrawal that also requires a Section 404 permit or a Federal Energy Regulatory Commission license or license re-issuance, as well as the same projects that do not require a Federal permit.

To realize a net gain in wetland acreage and function through voluntary programs involving wetland restoration and enhancement, Virginia has committed to restoring 6,000 new acres of wetlands by 2010 within Virginia's portion of the Chesapeake Bay. In addition, Virginia has set a goal of restoring 4,000 acres outside of the Bay drainage, for a total of 10,000 new acres statewide. It will be important to monitor and assess the success of these voluntary efforts.

The overarching goal of the wetland monitoring and assessment strategy is to develop a long-term implementation plan for a wetland monitoring and assessment program that protects the physical, chemical, and biological integrity of the Commonwealth's water resources, including wetlands. In order to accomplish this goal, it is critical to first know the status of wetland resources in Virginia, in terms of location and extent of wetlands in each watershed, and have a general knowledge of the quality of these wetland resources. Secondly, the functions of wetland resources impacted through our permitting program must be accurately evaluated to determine those functions to be replaced through compensatory mitigation. It is also important to assess the degree to which the required compensatory mitigation is performing in relation to those impacted functions.

State Water Control Law (§ 62.1-44.3) and Virginia Water Protection Permit (VWPP) regulations (9 VAC 25-210-10) define "State waters" as "*all water, on the surface and under the ground, wholly or partially within or bordering the Commonwealth or within its jurisdiction, including wetlands.*" Further, "wetlands" are defined as "*those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas.*" Virginia has narrative water quality standards for all surface waters, including wetlands. The overall water quality for state waters is assessed based on whether or not the condition of the waterbody being assessed permits citizens to safely enjoy the six designated uses of the water (aquatic life use, fish consumption use, swimming use, public water supply use, shellfish consumption use, and wildlife use), as described in the Virginia Water Quality Standards. Part of this wetland monitoring and assessment strategy will include the evaluation of these designated uses for their applicability to wetland condition as well as consider other designated uses of wetlands, with the possible goal of further developing specific wetland quality standards as narrative use criteria.

The ten-year strategy for wetland monitoring and assessment in Virginia follows the "Elements of a Wetland Monitoring and Assessment Program Checklist" developed by the United States Environmental Protection Agency (EPA) in October 2002, as well as the *Elements of a State Water Monitoring and Assessment Program* (EPA 841-B-03-003, March 2003) and *Application of Elements of a State Water Monitoring and Assessment Program for Wetlands* (unpublished draft, July 2005). DEQ's plan clearly articulates the goals and objectives for the assessment and monitoring of wetlands in Virginia. Rather than focusing on intensive monitoring of the quality of wetlands for the purposes of setting numeric wetland quality standards, our strategy is to use a three-tiered probabilistic approach to wetlands assessment, using a suite of core and supplemental indicators, to assess whether or not a particular wetland is performing at a similar condition as an identified reference wetland.

This approach is designed to generate a nested data set in which a minimum data set is available for all identified wetlands in the state, and more extensive information is available for selected subsets of wetlands. The hierarchical nature of the database allows for both general reporting on status and trends, as well as providing for more intense analysis of select watersheds for assessment of cumulative impacts to wetland functions and water quality. This assessment approach will generate data that will be used to conduct biannual reporting on status and trends of wetlands by watershed as part of Virginia's Integrated 305(b)/3039(d) report, and to evaluate the effectiveness of regulatory and voluntary programs in meeting Virginia's mandate of no net loss of wetland resources through

regulatory programs, and a net resource gain through voluntary programs. Our work links directly to the EPA's Strategic Plan Objective of Protecting and Restoring Ecosystems through Increasing Wetlands via state/federal partnerships aimed at ensuring no net loss and working toward a net gain of this important resource.

A. MONITORING PROGRAM STRATEGY

The overall wetland monitoring program strategy will establish baseline conditions in various broad contexts, such as land use, watershed, and wetland type. Using existing data sets from the National Wetlands Inventory (NWI), Landsat Thematic Mapper (TM) satellite, protocols developed by the Coastal Change Analysis Program (CCAP) of the National Oceanic and Atmospheric Administration (NOAA), U.S. Geologic Survey National Elevation Dataset (NED), and Digital OrthoPhoto Quads, an assessment of wetlands based on type and surrounding landscape is being conducted within a GIS framework by the Center for Coastal Resources Management at the Virginia Institute of Marine Science (CCRM-VIMS). The data set will be updated periodically, when resources allow, as revised land cover and NWI maps are updated. This information can then be used to guide management decisions regarding Virginia's wetland resources. This strategy provides the ultimate framework for an ongoing assessment of the status of the Commonwealth's wetland resources and the success of both our wetland regulatory and voluntary programs. This wetlands strategy will be coordinated with and will become an integral part of Virginia's comprehensive water quality monitoring program strategy.

B. MONITORING OBJECTIVES

DEQ's monitoring objectives are designed to support regulatory decision-making, allow reporting of wetland condition, and provide information for policy development. In particular, information derived from monitoring will be used to:

1. Report ambient wetland conditions in Virginia's Clean Water Act (CWA) Integrated 305(b)/303(d) report;

2. Assist in the evaluation of environmental impacts to wetlands of proposed projects during permit review as part of Virginia's regulatory program, including an assessment of cululative impacts to wetlands and water quality within a given watershed;

3. Evaluate the performance of wetland restoration and other compensatory wetland mitigation in replacing wetland acreage and function, including changes in wetland condition over time based upon surrounding landscape changes and maturity of the mitigation site; and

4. Evaluate the cumulative impacts of wetland loss and restoration in watersheds relative to ambient ecological conditions.

Virginia's monitoring program will also meet the CWA objectives for water monitoring programs by addressing the quality of the Commonwealth's wetlands and their condition as part of the overall condition assessment of state waters. In addition, DEQ's wetland monitoring and assessment program will provide the general public, resource agencies, land use planning entities, and

conservation groups with general information on the health and quality of the Commonwealth's wetland resources.

The following questions will be used to guide the performance measures for the wetland monitoring program objectives:

1. What is the overall quality of wetlands in Virginia?

To determine the extent to which wetlands, as part of State waters, meet the objectives of the CWA, Virginia will develop a baseline data set, documenting current conditions and the general quality of wetlands throughout the state. Using a Geographic Information System (GIS), a baseline map will be developed by overlaying wetlands, as depicted on National Wetland Inventory (NWI) maps and other data sources listed previously, and a wetland quality indicator developed from the use of a stressor checklist tool and wetland landscape position. This information will form the basis for reporting of ambient wetland condition in Virginia's Integrated 305(b)/303(d) reports. This information can be reported in the context of wetland types, land use, landscape position, or by watersheds, depending upon the information needed.

2. To what extent is wetland quality changing over time?

Virginia will use sequential survey information to look at changes in wetland quantity and quality over time. This temporal analysis will be accomplished by continuing to refine the wetland database with information on wetland losses and gains in each watershed using the permit tracking database, as well as periodically conducting wetland quality assessments in select watersheds. In addition, DEQ will incorporate information from our wetland compliance and inspection database, once this database is developed, tested, and implemented.

3. What are the wetland problem areas and areas needing protection?

The wetland assessment tools that will be applied to Virginia's nontidal wetlands will allow the characterization of wetland quantity and quality, and the determination of watersheds experiencing the largest change in wetland resources. This in turn will allow for management decisions to be made that could provide additional protections for watersheds experiencing significant declines in wetland quantity and/or quality. For instance, monitoring information could be used to identify exceptional value wetlands that should have greater protection within the context of permitting programs. Conversely, degraded wetlands could be identified that would be good candidates for targeting wetland restoration projects.

4. What level of wetland protection is needed?

Information on wetland quantity and quality will support the regulatory program's decision making process by allowing an assessment of cumulative impacts to wetlands and water quality within a watershed. The level of protection needed can be established by weighing the effectiveness of regulatory protections versus compensatory mitigation in replacing wetland functions within a given watershed.

5. How effective are wetland programs in protecting the resource?

Wetland monitoring data will be used in conjunction with other water monitoring data to evaluate the effectiveness of wetland protection programs in terms of meeting the goal of no net loss of

wetland acreage and functions. This will be accomplished through Section 305(b) reporting, and will include a determination of whether the wetland regulatory program is attaining this goal. In addition, wetland monitoring information can be used within the context of the following programs to address additional management measures: Section 319 (nonpoint source control), Section 314 (Clean Lakes), Section 303(d) Total Maximum Daily Loads (TMDLs), Section 402 (NPDES permits), and water quality standards modifications.

Virginia will incorporate updated NWI and GIS mapping into the wetland monitoring and assessment protocol as it becomes available and as resources allow. Further, field information collected by DEQ wetland permitting and inspection staff during regular compliance inspections and investigations of alleged wetland law violations will be integrated into the wetland monitoring and assessment database.

C. MONITORING DESIGN

Virginia has developed an approach and rationale for wetland monitoring designed to address its monitoring objectives. The assessment protocol is a three-tiered approach that considers both internal factors (specific to an individual wetland) and external factors (within the watershed and surrounding landscape). It is designed to address a wetland's ecological significance in a watershed, in terms of habitat and water quality functions. DEQ will integrate information from EPA's Environmental Monitoring and Assessment Program (EMAP), where appropriate, to further enhance the precision of our database.

Comprehensive coverage of all NWI mapped wetlands is achieved with a GIS-based analysis of remotely sensed information (census sampling). These data are summarized on the basis of small watersheds or hydrologic units. It provides a first order evaluation of the condition and functional capacity of wetlands based on their landscape position. The second level assessment is intended for use in a statistically selected sub-sample of the watershed wetland population, and involves a more sophisticated analysis of remotely sensed information and a site visit for verification and additional data collection. The third level assessment involves very detailed analysis of wetland performance of specific functions (habitat provision and water quality modification, in particular). This involves extensive sampling of a limited number of sites, specifically chosen to allow validation of the conceptual model of wetland function that underlies the Level 1 and Level 2 assessments. Each assessment level builds upon the data collected in previous assessment levels.

Level 1 - Landscape Level Assessment Protocol

Using existing data sets from the NWI, Landsat Thematic Mapper (TM) satellite, protocols developed by the Coastal Change Analysis Program (CCAP) of the National Oceanic and Atmospheric Administration (NOAA), U.S. Geologic Survey National Elevation Dataset (NED), and Digital OrthoPhoto Quads, an assessment of wetlands based on type and surrounding landscape will be conducted within a GIS framework by CCRM-VIMS. All GIS work will include metadata files.

The final product will be an interactive web site that will allow individuals to query the database using various different parameters, such as by watershed, by hydrologic unit code, or by wetland type to name a few. Virginia regulatory agencies will have access to this database to perform queries on individual parcels as well as at larger scales. Regulatory agencies will also be able to modify or edit the database to update information based upon site-specific changes. Prior to implementing editing permissions, a quality assurance/quality control protocol will be developed to assure that inadvertent errors are reduced or eliminated. The general public will also have access to this database through the interactive web site to query the database, but will not be given permissions to directly edit the database. At this time, it has not been determined if any restrictions will be placed on search parameters.

Prior to developing the scoring protocol for wetland condition, a list of potential parameters was compared to information from published literature regarding each parameter's validity, usefulness, and utility for field data collection. The revised list of parameters was further refined in conjunction with work being conducted through the Mid-Atlantic Wetland Workgroup (MAWWG) sponsored by EPA-Region III. Based upon information for the published literature and research being performed by various MAWWG participants, the parameters chosen for Virginia's Level 1 assessment wetland quality score include: (i) wetland size, (ii) wetland type, (iii) wetland hydroperiod; (iv) proximity to other wetlands; (v) proximity to roads and highways, (vi) density of roads and highways; and (vii) percent land cover (immediately adjacent to the study wetland, at a 200 meter radius from the study wetland, and at 200-1000 meter radius from the study wetland). Based upon the additional information from the published literature to further validate the chosen parameters and analysis of the chosen parameters, each wetland area in the study is given a separate score for habitat and for water quality. Habitat and water quality scores are presented in Appendix A. The Level 1 assessment has been completed for all non-tidal wetlands across the entire state and grouped by watershed (14-digit hydrologic unit code). The resulting data will be used as a baseline for measuring the status of Virginia's non-tidal wetland resources.

Level 2 - Rapid Assessment Protocol

A Level 2 assessment will be completed for Coastal Plain watersheds by December 2006 and for Piedmont watersheds by December 2008. Within a watershed, a representative number of stratified sample points will be randomly selected based on a statistically robust methodology similar to the EPA's E-Map protocol, but modified to select the study wetland's center point (centroid). Selecting the wetland centroid better addresses Virginia's need to assess stressors and disturbance impacts and to better analyze the data at varying spatial scales to include individual wetlands. The inherent bias of this approach is that larger wetland polygons are expected to exhibit less stressors at their center than are smaller wetlands. The randomly selected sample points will be stratified by palustrine forested (PFO), palustrine scrub-shrub (PSS), and palustrine emergent (PEM) wetland types. A stressor checklist (included in the definition section below) is then used for on-site evaluation of habitat function and water quality function. The Level 2 assessment checklist was developed after an intensive literature review to determine the most appropriate, and scientifically defensible, measures of stress on wetland ecosystems. The Level 2 assessment will be further refined by physiographic province as the Level 3 assessments are completed. The measurement procedures specified in the next section of the sampling protocol describe how conditions for individual sites are measured. The sampling and measurement procedure sections include

documentation and QA/QC procedures to ensure that the data area collected correctly and are reproducible, and are tied back to the Level 1 data for validation. The data management procedures are the final section of the sampling protocol. These procedures set forth how the data will be formatted for analyses and archived. Data management includes ensuring that the data are complete and correct.

The following information describes the sections of the sampling protocol in more detail:

Sampling Methods

The Level 2 Assessment protocol involves a collection and documentation of stressors, using a checklist developed in Microsoft Access on a Palm operating system platform, at each of the randomly selected sites. Stressors are identified within 30 meters of the wetland center and between 30-100 meters of the wetland center. This approach allows for differential weighting of various stressors based on their presumed deleterious effect and proximity to the wetland. The stressors to be used have been identified through previous EPA funded projects and collaborations with other research centers. The stressor checklist is not dependent upon weather conditions, as water samples will not be collected. The stressors, identified and defined below, identify dominant wetland type, vegetation alteration, hydrologic modification, presence of roads, sedimentation, and presence of toxics. A detailed description and guide for identifying stressors accompanies all field crews. The stressor checklist is programmed into a Palm handheld computer and taken into the field (see Appendix B for example screen-shot). Data can only be entered in appropriate boxes, and a decision must be made for each category or question before progressing to the next category or question. The field data collection is also time-stamped to provide information on the amount of collection time necessary to complete the fieldwork. A hardcopy form is also taken into the field for backup procedures. Data are downloaded from the field computer directly into the laboratory database to minimize data entry/transcription errors. Data are cross-checked for errors by the Field Data QA Manager and double-checked for completeness by the Computer Data QA Manager. Both of these personnel resources and site sampling personnel are provided to DEQ by CCRM-VIMS.

DEFINITIONS USED FOR LEVEL 2 ASSESSMENT STRESSOR CHECKLIST:

Assessment Site: Each wetland randomly selected for the Level 2 study is assigned a unique identifying number. Latitude/longitude at the center of each wetland site (or as close as practical) is recorded using a hand-held Global Positioning System (GPS) unit. Stressors are assessed within a 30 meter radius and between 30-100 meters of the wetland center.

Dominant Wetland Community Type.

> **Pine Forest**: Canopy consists of >50% *Pinus* species.
> **Pine Plantation:** Cultivated *Pinus* species.
> **Scrub-Shrub:** A layer of vegetation composed of woody plants < 7.5 cm in diameter at breast height but greater than 1 m in height, exclusive of woody vines.
> **Nonvegetated:** Unvegetated lands lying contiguous to mean low water and between mean low water and mean high water.

Vegetation Alteration

Mowing: Mechanized cutting of herbaceous ground cover at least annually.
Brush cutting: Cutting or removal of scrub and shrub species.
Excessive herbivory/grazing: Significant detrimental grazing of vegetation (deer – browse line, waterfowl-herbaceous vegetation, beaver – trees, livestock – herbaceous vegetation).
Utility easement maintenance: mowing, spraying, brush-cutting in association with maintaining utility (gas, water, oil, electrical, communication) easements.
Timber harvesting (within 5 years): Evidence of selective removal of canopy species within 5 years.
Clear cutting (within 5 years): > 90% canopy removal within 5 years.
Invasive species (>20%): See the Department of Conservation and Recreation, Division of Natural Heritage publication "Invasive Alien Plant Species of Virginia". Record if percent cover on assessment site is estimated to be greater than 20.

Hydrologic Modification

Drain/Ditch: Human-constructed alteration that conveys water offsite decreasing hydroperiod.
Dike/Weir/Dam: Structure that impedes flow of water offsite – increasing hydroperiod.
Beaver Dam: Active or inactive beaver dam that impedes flow of water offsite.
Filling/grading: Discharge of material into wetlands.
Dredging/excavation: Mechanized removal of soils/sediments from wetland.
Stormwater inputs/culverts/ditch: Point-source conveyance of water into wetland.
Other: Provide written description in comment section.

Road Beds

1. Note number and type of separate road incursions in comment section.
2. Note whether road crosses the any stream or creek associated with the wetland.
3. Note whether any railroad incursions are active or abandoned.
4. Four lane (or greater) paved roadways includes divided highways.
5. Other: Provide written description in comment section.

Sedimentation

Sediment deposits/plumes: Evidence of excessive accumulation of sediment usually visible as exposed deposits on wetland surface or as turbid water due to suspended sediments.
Eroding banks/slopes: Undercut or slumping banks/slopes with exposed soil.
Active construction: Current land disturbance due to construction activity.
Active plowing: Current tilling or disking of cropland.
Unfenced livestock access: Land that currently supports livestock that are not restricted from wetland.
Timber harvesting (within 5 years): Evidence of selective removal of canopy species within 5 years.
Clear cutting (within 5 years): > 90% canopy removal within 5 years.

Other: Provide written description in comment section.

Toxicity/Nutrification

Point Source Discharge: evidence of concentrated discharge entering wetland.
Potential for Non Point Source Discharge: Activities that may contribute toxics and/or nutrients to wetlands through diffuse flows (including livestock and concentrations of waterfowl).

Level 3 Assessment

A critical part of the overall wetland monitoring and assessment strategy is effective validation and calibration of the underlying models. The Level 3 assessments are designed to specifically evaluate performance of functions in wetlands under varying degrees of stress – as indicated by the Level 1 and 2 protocols. A Level 3 Assessment will be completed for targeted watersheds on a rotating basis, starting with the watersheds most heavily experiencing development pressures and hence having the most potential for cumulative impacts to wetlands. To accomplish this Virginia will select sites within watersheds that are representative of the most common wetland types and conditions. At these sites Virginia will undertake direct measurement of the sites' performance of habitat and water quality functions. The objective of the sampling will be to test for correlations between the ability of a site to perform key wetland functions and identified stressor levels. The habitat assessment will initially focus on the avifauna and amphibian populations as these taxa are generally considered responsive to ecosystem stress and represent a biological endpoint for habitat function. In this manner, the assessment procedure avoids the pitfalls of other methodologies that consider indicators of biological endpoints rather than the direct function. Water quality functions, in terms of abilities to filter nutrients, will initially focus on measures of departure from normal of wetland water budgets due to stressors.

Our current plan identifies 10 sites in the coastal plain of Virginia. Sites will then be assessed under the current project protocol based on the distribution of wetland types in the coastal plain, and availability of ancillary data. To the extent possible Virginia will be using sites that have been studied for other purposes, such as development of HGM models. This will maximize the utility of the developed data. Virginia will then extend the level 3 sampling to an additional 10 sites selected in the Piedmont by August 2006.

D. CORE AND SUPPLEMENTAL WETLAND QUALITY INDICATORS

The overall water quality for Virginia is evaluated on whether or not the condition of the waterbody being assessed allows citizens to safely enjoy the six designated uses of the water as described in the Virginia Water Quality Standards. The table below briefly describes the six designated uses and the baseline criteria used in the 305(b) Water Quality Assessment to demonstrate support of the designated uses.

No.	Designated Use	Support of Use Demonstrated By
1	Aquatic Life Use	Conventional Pollutants (Dissolved Oxygen, pH, Temp.); Toxic contaminants in water column; Nutrients and toxic contaminants found in sediments exceeding NOAA's Effects Range -Median Value; Biological evaluation.
2	Fish Consumption Use	Advisories, limiting consumption, or restrictions issued by Virginia Department of Health (VDH); Comparison of fish tissue data to state screening values for toxic pollutants.
3	Swimming Use	Conventional Pollutant (Fecal Coliform Bacteria) and/or beach closures issued by VDH
4	Public Water Supply Use	Closures or advisories by VDH; comparison of data to applicable public water supply standards
5	Shellfish Consumption Use	Restrictive actions for harvesting and marketing of shellfish resources made by Div. Of Shellfish Sanitation of VDH.
6	Wildlife Use	Aquatic life toxics criteria in water column.

DEQ will evaluate these designated uses for their applicability to wetland condition as well as consider other designated uses of wetlands based upon their functions, with the goal of developing wetland quality standards as narrative use criteria. Once wetland quality standards are developed, DEQ will evaluate a suite of core and supplemental indicators to assess whether or not a particular wetland is meeting the standard. It is likely that these indicators will include key stressors as measured in the wetland condition assessment as well as appropriate indices of biological integrity, such as the Floristic Quality Assessment Index (FQAI).

E. QUALITY ASSURANCE

Quality Assurance Project Plans (QAPPs) for each phase of wetland monitoring either have been developed, maintained, and peer reviewed in accordance with EPA and state policy to ensure the scientific validity of all monitoring activities. As part of our current work, Virginia has developed, and EPA has approved, a QAPP for the Level 1 and initial Level 2 Assessment studies (see Appendix C).

F. DATA MANAGEMENT

An accessible electronic data management system will be developed within an interactive GIS framework to manage and store data. Initially, the data will reside on CCRM-VIMS servers, and will be accessible to DEQ staff and the public via web browsers. DEQ staff and the public will be able to query the data by several different parameters, including watershed (by hydrologic unit code), wetland type, or stressor. DEQ's existing web site will provide a link to the data stored on CCRM-VIMS servers. Further, DEQ will explore the utility of integrating the data into DEQ's Comprehensive Environmental Database System (CEDS). To the extent that EPA's STORET

system is set up to accommodate these data, DEQ will develop a protocol to regularly upload these data.

G. DATA ANALYSIS/ASSESSMENT

Initially, the data will be analyzed by wetland type and watershed with wetland-specific scores for habitat and water quality. These data can also be analyzed in various other spatial and temporal ways to generate comparisons of relative wetland condition. Examples of different wetland quality data analyses may include:

- Comparison of wetland condition within a watershed and between watersheds
- Comparison of wetland condition within a locality and between different localities
- Comparison of wetland condition within a watershed or locality over time
- Comparison of wetland condition between wetland types
- Correlation of wetland type and specific stressor
- Comparison of wetland condition within and between hydrogeomorphic (HGM) classes
- Comparison of wetland condition within a specific wetland over time

Initially, both habitat and water quality scores developed from the Level 2 Assessment will be normalized on a 0-1 scale. Generally, a higher score is indicative of a healthier wetland; a lower score is indicative of a degraded wetland. Assigning scores for individual wetlands allows for simpler comparisons of relative wetland condition for the general public. To increase the "friendliness" for the end-user and to increase the inferences that can be teased from these data, the database has been designed to maximize flexibility in the types of analyses that can be performed. Using the interactive web site, end-users will be able to select the parameter(s) of interest through a hierarchical, iterative process based on their analytical needs. Depending on the parameters selected for a particular query, the scoring for a specific wetland may differ between iterative queries. With this flexible analytical design, the data lend themselves to multiple combinations of analysis to meet both regulatory and non-regulatory needs.

The randomly selected wetlands evaluated in the Level 2 Assessment then become a reference standard against which to compare other wetlands. Level 1, 2, and 3 assessment data will be used to analyze thresholds (breakpoint analysis) to define wetland condition (i.e. not restorable, low, medium, high). Additionally, subsequent visits to the Level 2 evaluation sites will allow for temporal analyses of the reference standard to measure not only spatial changes, but also temporal changes. This temporal study can be used to re-calibrate the assessment model, re-evaluate regulatory policies, incorporate the revised data into decision matrices for cumulative impact analyses, and evaluate whether wetland quality goals are being achieved. As land cover maps are updated by other agencies and programs, the temporal wetland data, coupled with updated land cover imagery, will yield a more accurate and robust data set.

H. REPORTING

To achieve the CWA objective of "*maintain*[ing] *and restor*[ing] *the chemical, physical, and biological integrity of our Nation's waters, including wetlands*", Section 305(b) of the CWA requires each state to submit a biennial report to EPA describing the quality of its waters. Further, the CWA Section 303(d) report provides individual listings of waters designated as "impaired" for one or more designated uses. Using a probabilistic approach for wetland monitoring, the wetland assessment data can be incorporated into the biennial Integrated 305(b)/303(d) report. As these data can be updated over time based on land cover changes within watersheds, it may be possible to use the data to potentially target voluntary wetland
restoration initiatives, direct wetland mitigation bankers to impaired watersheds, or adjust wetland mitigation ratios through the regulatory permitting program.

In 2000, the Virginia General Assembly passed legislation directing DEQ's Office of Wetlands & Water Protection to expand the existing Section 401 Certification program into an independent state nontidal wetland program. Further, this legislation required DEQ to ensure, through both regulatory and non-regulatory initiatives, that the Commonwealth achieves a "no net loss" of wetland acreage and function (emphasis added). In addition to incorporating wetland condition data into the Integrated 305(b)/303(d) report, we plan to produce a separate document, on either a biennial or triennial cycle, for the general public that describes not only the status of wetland acreage gains/losses through the permitting and voluntary restoration programs, but also incorporates the three tiered monitoring and assessment data to evaluate trends in wetland condition. We plan to analyze the data in various ways to provide meaningful, and easily understood, inferences of wetland condition for the general public. Virginia anticipates analyzing the data by watershed to give a snapshot of wetland condition across the Commonwealth. Over time, a trend analysis can be included in this publication to illustrate whether Virginia is meeting the goals of improved wetland condition and function through our wetland programs.

Wetland data collected will be incorporated into the 2008 Integrated 305(b)/303(d) Report to EPA, as available, and in all future reports. By February 2008, we plan to issue our first Wetland Quality Status and Trends Report, pending available funding.

I. PROGRAMMATIC EVALUATION

During the course of implementation of this long-term monitoring strategy, DEQ will conduct periodic evaluations to assess both progress made toward monitoring milestones as well as how the information collected is being used to support management decisions. By October 2007 DEQ will have in place performance measures to assess implementation of our strategy. DEQ will then conduct programmatic evaluations on a biannual basis, and make mid-course corrections as needed.

J. GENERAL SUPPORT AND INFRASTRUCTURE PLANNING

As part of this strategy, DEQ will identify future monitoring resources needed to fully implement our wetland monitoring program strategy. This will include state funding, federal funding, and

potential grant sources from state and federal agencies, non-governmental organizations, or private foundations that support wetland programs.

SUMMARY

The overarching goal of the wetland monitoring and assessment strategy is to develop a long-term wetland monitoring and assessment program that protects the physical, chemical, and biological integrity of the Commonwealth's water resources. The hierarchical nature of Virginia's wetland monitoring and assessment strategy allows for both general reporting on status and trends, as well as providing for more intense analysis of select watersheds for assessment of cumulative impacts to wetland condition and water quality. This assessment approach will generate data that will be used to conduct biannual reporting on status and trends of wetlands as part of Virginia's Integrated 305(b)/303(d) report, and to evaluate the effectiveness of regulatory and voluntary programs in meeting Virginia's mandate of no net loss of wetland resources through regulatory programs, and a net resource gain through voluntary programs. Further, our interactive database and Wetland Quality Status and Trends Report will provide the general public, resource agencies, land use planning entities, and conservation groups general information on the health and condition of the Commonwealth's wetland resources. DEQ expects that this strategy can be accomplished within a ten-year time frame (see Appendix D).

APPENDIX A

Level 1 Assessment Scoring

Level 1 Assessment Scoring

Wetland Type	Habitat Score	Water Quality Score
PEM	0.8	0.7
PSS	0.9	1.0
PFO	1.0	1.0
LEM	0.6	0.6
REM	0.8	0.6

Total Scores possible for Wetland Type:

	Highest	Lowest
Habitat	1.0	0.6
Water Quality	1.0	0.6

Wetland Size (ha)	Habitat Score	Water Quality Score
≤0.04	0.0	0.0
>0.04-0.5	0.1	0.1
0.5.1-1.0	0.2	0.2
1.1-5.0	0.3	0.4
5.1-10	0.5	0.6
10.1-40	0.8	0.8
40.1-200	0.9	0.9
>200	1.0	1.0

Total Scores possible for Wetland Size:

	Highest	Lowest
Habitat	1.0	0.0
Water Quality	1.0	0.0

Percent land cover type (adjacent to wetland, within 200 m radius of wetland, and within 200-1000m of wetland) for Habitat

Land cover Type	Initial score	Adjacent	To 200m	200-1000m	HUC
Wetland	1.0				
Forest	1.0				
Water	1.0				
Transition	0.9				
Pasture	0.7				
Cropland	0.5				
Bare rock/sand	0.5				
Residential	0.2				
Urban	0.0				
Industrial	0.0				

Final score within each assessment area = (% cover of land use type) (Initial score)

Percent land cover type (adjacent to wetland, within 200 m, and within 200-1000m of wetland within the drainage area) for Water Quality

Land cover Type	Initial score	Adjacent	To 200m	200-1000m	Drainage within HUC
Wetland	1.0				
Forest	1.0				
Water	1.0				
Transition	1.0				
Pasture	0.6				
Cropland	0.4				
Residential	0.2				
Bare rock/sand	0.0				
Urban	0.0				
Industrial	0.0				

Final score within each assessment area = (% cover of land use type) (Initial score)

Total Scores possible for Surrounding land cover type:
Function	Highest	Lowest
Habitat	3.0	0.0
Water Quality	3.0	0.0

Habitat Scores for Proximity to Roads
If roads are within or adjacent wetland then score = 0.0
If roads are within 200m of wetland then score = 0.1
If roads are within 200- 1000m of wetland then score = 0.4
If roads greater than 1000m from wetland then score = 1.0

Habitat Scores for Proximity to Highways
If highways are within or adjacent wetland then score = 0.0
If highways are within 200m of wetland then score = 0.1
If highways are within 200- 1000m of wetland then score = 0.4
If highways greater than 1000m from wetland then score = 1.0

Water Quality Scores for Proximity to roads and road alignment.
    Road alignment within or adjacent to wetland.
        If roads are within or adjacent wetland then score = 0.0
        If roads are not within or adjacent wetland then score = 1.0
    Road alignment within 200 meters in upstream drainage.
        If roads cross one side of drainage area within 200 m of wetland: score = 0.1
        If roads cross both sides of drainage area within 200 m of wetland: score = 0.0
        If roads do not cross drainage area within 200 m of wetland then score = 1.0

Road alignment within 200–1000 meters in upstream drainage.
      If roads cross one side of drainage area within 200–1000 m of wetland: score = 0.2
      If roads cross both sides of drainage are within 200–1000 m of wetland: score = 0.1
      If roads do not cross drainage area within 200 - 1000 m of wetland: score = 1.0

Water Quality Scores for Proximity to highways and highway alignment.

Highway alignment within or adjacent to wetland.
      If highways are within or adjacent wetland then score = 0.0
      If highways are not within or adjacent wetland then score = 1.0
Highway alignment within 200m in upstream drainage.
      If highways cross one side of drainage area within 200 m of wetland: score = 0.1
      If highways cross both sides of drainage area within 200 m of wetland: score = 0.0
      If highways do not cross drainage area within 200 m of wetland then score = 1.0
Highway alignment within 200m – 1000m in upstream drainage.
      If highways cross one side of drainage area within 200–1000 m of wetland: score = 0.2
      If highways cross both sides of drainage are within 200–1000 m of wetland: score = 0.1
      If highways do not cross drainage area within 200 - 1000 m of wetland: score = 1.0

Total Scores possible for Proximity and Alignment of Roads and highways:

Function	Highest	Lowest
Habitat	2.0	0.0
Water Quality	6.0	0.0

Road Density
Calculate road density as linear distance (meter) per area (adjacent, 200m, 200-1000m, watershed)
Calculate highway density as linear distance (meter) per area (adjacent, 200m, 200-1000m, watershed)

Habitat Score for Proximity to other Wetlands
If < 200 m score = 1.0
If 201- 1000 m score = 0.5
If > 1000 m score = 0.0

Total Scores possible for Proximity to other Wetlands

Function	Highest	Lowest
Habitat	1.0	0.0

Wetland hydroperiod

Habitat Score	Water Quality Score
A, B, H, J, K, U, W, Z = 0.5	H, J, K, U = 0.5
C, D, E, F, G, R, Y = 1.0	A, B, C, D, E, F, G, R, W, Y, Z = 1.0

Total Scores possible for Wetland Hydroperiod

Function	Highest	Lowest
Habitat	1.0	0.5
Water Quality	1.0	0.5

Hydroperiod Definitions

A = Temporarily Flooded - Surface water present for brief periods during the growing season, but the water table usually lies well below the soil surface. Plants that grow both in uplands and wetlands are characteristic of this water regime.

B = Saturated - The substrate is saturated to the surface for extended periods during the growing season, but surface water is seldom present.

C = Seasonally Flooded - Surface water is present for extended periods especially early in the growing season, but is absent by the end of the growing season in most years. The water table after flooding ceases is very variable, extending from saturated to a water table well below the ground surface.

D = Seasonally Well-drained - Surface water is present for extended periods especially early in the growing season. The water table after flooding ceases falls well below the ground surface. (Not used on all maps.)

E = Seasonally Saturated - Surface water is present for extended periods especially early in the growing season, and remains saturated near the surface for most of the growing season. (Not used on all maps.)

F = Semi-permanently Flooded - Surface water persists throughout the growing season in most years. When surface water is absent, the water table is usually at or very near the land surface.

G = Intermittently Exposed - Surface water is present throughout the year except in years of extreme drought.

H = Permanently Flooded - Water covers the land surface throughout the year in all years.

J = Intermittently Flooded - The substrate is usually exposed, but surface water is present for variable periods without detectable seasonal periodicity. Weeks, months or even years may intervene between periods of inundation. The dominant plant communities under this regime may change as soil moisture conditions change.

K = Artificially Flooded - The amount and duration of flooding is controlled by means of pumps or siphons in combination with dikes or dams. Water and waste-water treatment facilities are included in this modifier.

U = Unknown - The water regime is not known.

W = Intermittently Flooded/Temporary - Exhibits features of both Intermittently Flooded (J) and Temporary (A) water regimes. (Not used on all maps.)

Y = Saturated/Semi-permanent/Seasonals - Exhibits features of the Saturated (B), Semi-permanent (F) and Seasonal (C, D and E) water regimes. (Not used on all maps).
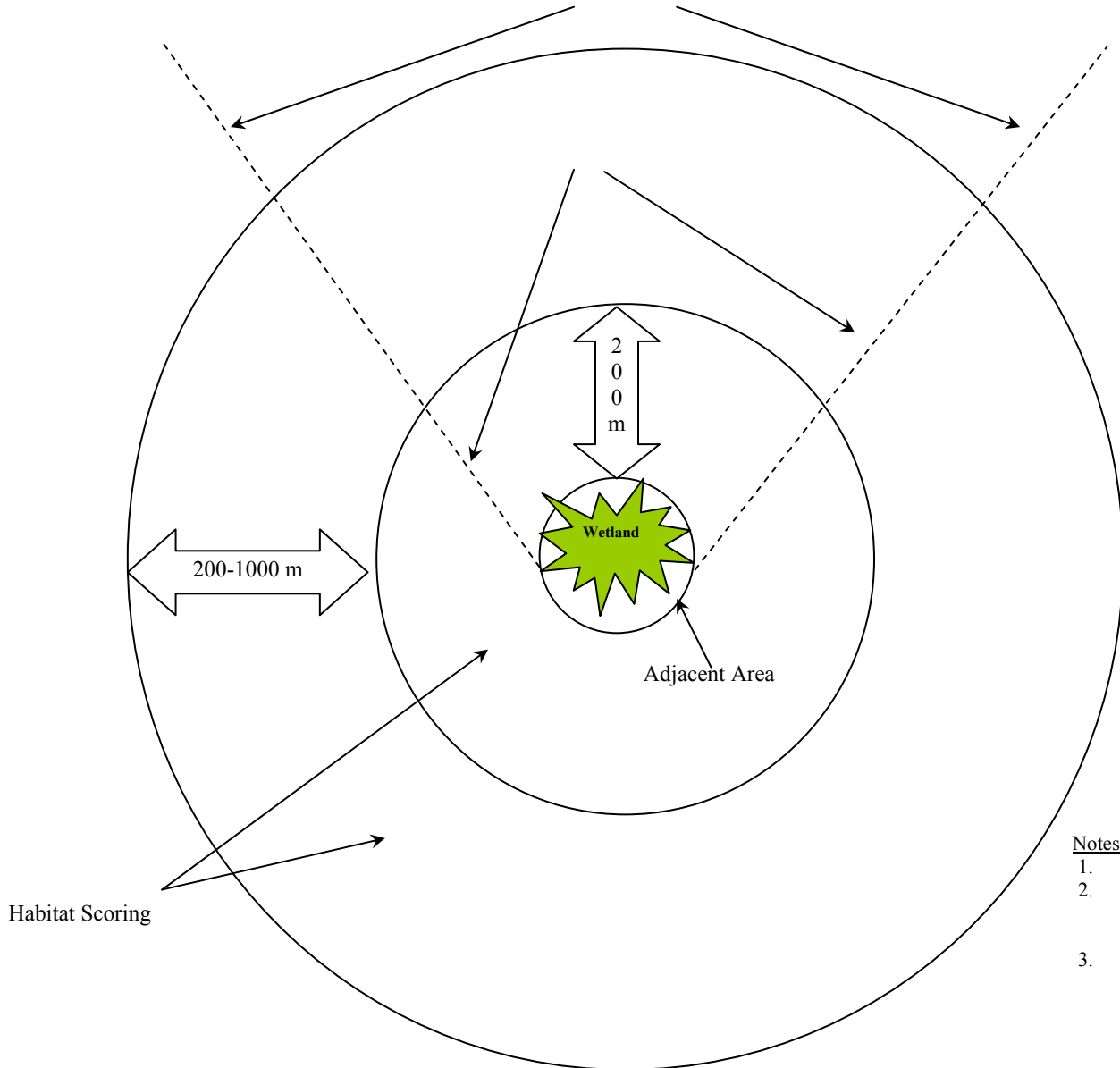
Z = Intermittently Exposed/Permanent - Exhibits features of both Intermittently Exposed (G) and Permanent (H) water regimes. (Not used on all maps.)

TOTAL POSSIBLE SCORES FOR LEVEL 1 ASSESSMENT:

	Highest	Lowest
Habitat	9.0	1.1
Water Quality	12.0	1.1

FIGURE 1

Level 1 Assessment Schematic

2
0
0
m

200-1000 m

Wetland

Adjacent Area

Habitat Scoring

Notes:
1. Sketch not to scale;
2. Habitat analysis conducted within entire radii;
3. Water quality analysis conducted within drainage area of radii only.

APPENDIX B

Level 2 Assessment Protocol:
Stressor Data Sheet

Wetland/Stream Stressors and Water Quality Data Sheet

Site Name

Evaluation date
yyyy/mm/dd

Investigator:

Community Type:	**HGM Classification**	**Forest Age Class:**	**GPS Coordinates (UTMs): 18 S**
EEM	Depression	Mature Forest > 50 years	
ESS	Slope	Young Forest 25-50 years	
EFO	Fringe	Successional Forest 5-25 years	
PEM	Mineral Flat	No Forest	**BAF 5 Count:** 0
PSS	Organic Flat		
PFO	Riverine		**BAF 10 Count:** 0
LEM	Headwater Floodplain		
REM	Mainstem Floodplain	**Comments**	
	Other		

Field Verification of Aerial Photos

Hydrologic Modification | **Toxics** | **Vegetation Alteration** | **Sedimentation** | **Roadbeds**

Hydrologic Modification Form

Site Name

No Hydrologic Modification (within 30m) ☐ (30 - 100m) ☐

Drain/Ditch (within 30m) ☐ (30-100m) ☐

Dike/Weir/Dam (within 30m) ☐ (30-100m) ☐

Beaver Dam (within 30m) ☐ (30-100m) ☐

Filling/Grading (within 30m) ☐ (30-100m) ☐

Dredging/Excavation (within 30m) ☐ (30-100m) ☐

Stormwater Inputs/Culvert/Ditch (within 30m) ☐ (30-100m) ☐

Other Hydrologic Modifications (within 30m) ☐ (30-100m) ☐

Hydrologic Comments

Sedimentation Form

Site Name

No Sedimentation (within 30m) ☐ (30-100m) ☐

Sediment Deposits/Plumes (within 30m) ☐ (30-100m) ☐

Eroding Banks/Slopes (within 30m) ☐ (30-100m) ☐

Active Construction (within 30 m) ☐ (30-100 m) ☐

Active Plowing (within 30 m) ☐ (30-100 m) ☐

Unfenced Cattle Access (within 30m) ☐ (30-100m) ☐

Active Timber Harvesting (within 1 yr) (within 30 m) ☐ (30-100m) ☐

Active Clear Cutting (within 1 yr) (within 30m) ☐ (30-100m) ☐

Other Sedimentation (30m) ☐ (30-100m ☐

Sedimentation Comments

Toxicity/Acidification/Nutrification Form

Site Name

No Toxic Activity (within 30m) ☐ (30-100m) ☐
Point Source Discharge of Toxics/Nutrients (within 30m) ☐ (30-100m) ☐
Potential Non-Point Discharge of Toxics/Nutrients (within 30m) ☐ (30-100m) ☐
Other Toxic Activity (30m) ☐ (30-100m) ☐

Toxic Comments

Vegetation Alteration Form

Site Name

No Vegetation Alteration (within 30m) ☐ (30-100m) ☐
Mowing (within 30m) ☐ (30-100m) ☐
Brush Cutting (within 30m) ☐ (30-100m) ☐
Excessive Herbivory/Grazing (within 30m) ☐ (30-100m) ☐
Utility Easement Maintenance (within 30m) ☐ (30-100m) ☐
Herbicide Application (within 30m) ☐ (30-100m) ☐
Timber Harvesting (within 5 yrs) (within 30m) ☐ (30-100m) ☐
Clear Cutting (within 5 yrs) (within 30m ☐ (30-100m ☐
Invasive Plants > 20% (within 30m) ☐
Invasive Species (within 30m)
Invasive Plants > 20% (30-100m) ☐
Invasive Species (30-100m)
Other Vegetation Alteration (30m) ☐ (30-100m) ☐

(If an adjacent buffer is observed)   **Buffer**
Forest Age Class:

Mature Forest > 50 years
Young Forest 25-50 years
Successional Forest 5-25 years
No Forest

BAF 5 Count: 0
BAF 10 Count: 0

Vegetation Comments

Roadbeds

Site Name

☐ No Roadbeds (30 m)
☐ No Roadbeds (30-100m)

>= 4 Lane Paved (30m) ☐ (30-100m) ☐
2 Lane Paved (30m) ☐ (30-100m) ☐
1 Lane Paved (30m) ☐ (30-100m) ☐
Gravel Road (30m) ☐ (30-100m) ☐
Dirt Road (30m) ☐ (30-100m) ☐
Railroad (30m) ☐ (30-100m) ☐
Other Roadbed (30m) ☐ (30-100m) ☐

Road Comments

Field Verification of Aerial Photo

Site Name

No new activity within 200 m	☐		**No new activity within 1 km**	☐
Obvious new activity within 200 m	☐		**Obvious new activity within 1 km**	☐

Area (sq. meters)   **Area (sq. ha)**

Planted Pine Forest (200m)   (1km)

Agriculture/Pasture (200m)   (1km)

Agriculture/Cropland (200m)   (1km)

Industrial (200m)   (1km)

Urban - High Intensity Residential (200m)   (1km)

Rural - Low Intensity Residential (200m)   (1km)

Roadway (200m):   (1km)

Other (200m)   (1km)

Field Verification Comments

APPENDIX C

**Quality Assurance Project Plan (QAPP)
for Wetland Monitoring and Assessment**

APPENDIX D

**Proposed Wetland Monitoring
Strategy Time Line**

PROPOSED TIME LINE WETLAND MONITORING & ASSESSMENT STRATEGY	
Key Strategy Tasks	**Target Date**
Select 10 Pilot Sites (Coastal Plain only) for Future Level 3 Assessment	COMPLETE
Complete Level 1 Assessment (Statewide)	COMPLETE
Required Resources Identified	COMPLETE
Finalize Monitoring & Assessment Strategy	COMPLETE
Select 10 Pilot Sites (Piedmont only) for Future Level 3 Assessment	August 2006
Complete Level 2 Assessment (Coastal Plain only)	December 2006
Strategy Performance Measures	October 2007
Wetland Status & Trends Report	February 2008 and then biannually
Integrate Wetland Assessment Data into 305b/303d Report	April 2008 and on-going
Complete Level 2 Assessment (Piedmont only)	December 2008